Evaluation of Geophysical Methods for the Detection of Subsurface Tetrachloroethylene in Controlled Spill Experiments

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Tetrachloroethylene (PCE), typically used as a dry cleaning solvent, is a predominant contaminant in the subsurface at Superfund sites. PCE is a dense non-aqueous phase liquid (DNAPL) that migrates downward into the earth, leaving behind areas of residual saturation and free product pools on areas of low permeability. These can act as long-term sources of drinking water contamination. Effective remediation requires the location of the non-aqueous phase PCE in the subsurface. The purpose of the current research is to evaluate the use of geophysical methods to detect this PCE. A series of controlled spill experiments have been conducted in which measurements with a number of geophysical methods were made before, during, and after the injection of PCE into the subsurface. These results clearly identified any geophysical anomaly associated with the PCE.

These experiments were conducted at the Canadian Forces Base Borden with the University of Waterloo and at the Oregon Graduate Institute with the U.S. Geological Survey (USGS). A number of different geophysical methods were tested in each of these experiments with good success. However, the presence of steel walls and tanks to contain the migration of the PCE prevented the evaluation of a number of geophysical methods. In order to evaluate these other geophysical methods, the current experiment was conducted with the Lawrence Berkeley National Laboratory (LBNL) in a nonmetallic fiberglass tank at the University of California, Berkeley, Richmond Field Station.

In May 2004, an experiment was conducted in which 85 liters of PCE was injected into the subsurface of a constructed sand and sand/clay formation. Ten different geophysical methods were utilized to monitor the subsurface properties before, during, and after the injection. These research activities involved six scientists from the USGS, three scientists from the LBNL, and two U.S. Environmental Protection Agency (U.S. EPA) scientists. Preliminary results show significant changes in the responses of most of the geophysical methods with the presence of the PCE. The results are currently undergoing analysis to provide PCE detection limits of the various geophysical methods.

The results of the current research will be published in the peer-reviewed literature and incorporated into a revised version of the Geophysics Advisor Expert computer program. This program has been widely used by the U.S. EPA remedial project managers and other hazardous waste site investigators.

The current results will provide better guidance on the use of geophysical methods for the subsurface detection of DNAPLs at hazardous waste sites.

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